

Italy: Road Weather Modeling

Forecasting ice formation on Italian road surfaces



The sensors mounted on the front of the road-map vehicles are a Garmin geographic position sensor and an IRTS precision infrared thermometer (silver cylinder pointed downward at an angle).

To many, the name Italy is associated with sun and warm weather. This is often a true enough picture. But Italy is also a country of mountains; snow and ice could show up anywhere, throughout winter. This is why the Province of Perugia, in the very center of Italy, has set up a program for forecasting of ice formation on road surfaces. The program is operated by the University of Perugia and Ecosearch, a Campbell Scientific systems integrator based in Italy.

The first part of the program is aimed to verify: 1) The relation between meteorological parameters indicating possible ice formation and the actual formation of ice in three selected sites and 2) the variability of road surface temperature.

Based on the results of this first part of the program, an extended network of meteorological stations would be implemented in the future.

The monitoring stations

Due to budget limitations, costly ice detection systems (spectral cameras) could not be considered. On the other hand, extended studies showed that the reliability of traditional systems based on road temperature, wetness and conductivity are far from reliable. It was therefore decided to approach the problem pragmatically. Three experimental stations would monitor the main meteorological parameters, together with soil temperature, conductivity and heat flux. In addition, a wetness sensor equipped with a heater would work as an ice detector: when the meteorological

Case Study Summary

Application

Road Weather Modeling with a mobile system

Location

Perugia, Italy

Products Used

CR10X, CD294

Contributors

University of Perugia and Ecosearch, a systems integrator

Participating Organizations

Province of Perugia

Measured Parameters

In mobile system: road temperature (infrared and surface temperature), geographic position (GPS), and distance (odometer)

In field stations: meteorological parameters plus soil temperature, conductivity, heat flux, and surface wetness

parameters indicate that ice formation is possible, the heater goes on. The change in resistance would indicate the transition from dry to wet (in this case, the ice melted by the heater would wet the sensor surface).

The University of Perugia would then develop an algorithm to relate weather and road parameters to the actual ice formation on the wetness sensor (the sensor itself is placed right above a surface reproducing the road surface coating).

The mapping system

To evaluate the variability of road surface temperature, mapping systems were required. These consisted of a data acquisition system (CR10X) connected to an infrared precision thermometer (IRTS-P from Apogee); the exact position of each reading was determined by a high precision GPS system from Garmin, (shown left on the front wing of the vehicle) coupled with an electronic odometer from Trumeter (pictured below on the rear of the vehicle.)

The mapping system needed to be as "friendly" as possible. The operator must be able to input his code and the road code allowing him to see the measured values on a display. The system is therefore equipped with the DataView display and an additional keypad has been connected. The system has an external fast connector for the temperature sensor, GPS and odometer. The internal battery can be recharged through the vehicle cigar lighter connection. Three systems are installed on three road maintenance vehicles. The precision of the temperature measured by the IRTS-P on the surface is verified through comparison with a high precision contact thermometer from Delta Ohm.

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An odometer fitted to one of the road-map vehicles in the Perugia, Italy, road ice project, makes precise measurements of distance traveled.



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